WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 6th Semester Examination, 2021

CEMADSE06T-CHEMISTRY (DSE3/4)

POLYMER CHEMISTRY

Time Allotted: 2 Hours   Full Marks: 40

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

Answer any *three* questions taking one from each group

GROUP-A

(Unit 1, 2 and 3)

1. (a) 'All polymers are macromolecule but all macromolecules are not polymer'. Explain with example.   2

   (b) Write the structural formula of the polymer having the following IUPAC names   2
       (i) poly[oxy(1-oxohexane-1, 6-diyl)]
       (ii) poly[oxy(1-methylethylene)]

   (c) Derive an expression for p(extent of reaction) for a system with a functionality f and show that when average degree of polymerization (D_p) goes to infinity, $p = 2/f$.   3

   (d) Give examples of any two commonly used initiators in anionic polymerization.   2

   (e) Show that molecular weight of polymer synthesized by cationic polymerization process is independent of the concentration of the initiator.   4

2. (a) Define homopolymer and copolymer with an example. Mention two factors which influence monomer reactivity ratio in copolymerization.   2+1

   (b) How are polymerization processes classified according to Flory and Carothers? Derive and justify that a large enhancement in number average degree of polymerization $\langle x_n \rangle$ value is observed, as the reaction proceeds to completion.   2+2

   (c) Describe the importance of water in emulsion and suspension polymerization. Is water a solvent?   2

   (d) Derive an expression for the rate of propagation for chain growth polymerization in terms of monomer and initiator concentration.   4

GROUP-B

(Unit 4, 5, 6 and 7)

3. (a) Discuss how the structure of a polymer crystal is characterized experimentally.   3

   (b) Differentiate between elastomer and fibre with example.   3

   (c) A solution contains equal masses of two substances with molar masses 10000 g mol⁻¹ and 20000 g mol⁻¹ respectively. Calculate $\overline{M}_n$ and $\overline{M}_w$.   2

   (d) Discuss in brief the methodology of determination of molar mass of a polymer using osmotic pressure measurements.   3

(e) Mention and explain the thermal transitions observed in a polymer. 3

4. (a) Explain why linear polyethylene with crystalline melting point, $T_m = 135°C$ rarely dissolves in solvents below 100°C, but nylon-66 with $T_m = 265°C$ can dissolve in solvents, particularly polar, even at room temperature. 2

(b) Why do isotactic polymers have high T_m, degree of crystallinity and tensile strength compared to atactic ones? 2

(c) Why Nylon makes good fibres? Natural rubber and Gutta percha both are naturally occurring polyisoprene but rubber is flexible and Gutta percha is hard. Explain. 3

(d) Define specific and intrinsic viscosity. Using the Mark-Houwink equation for the intrinsic viscosity, $[\eta] = kM^a$, show that viscosity average molar mass of a polymer is $M_v = \left(\frac{\sum_i N_i M_i^{1+a}}{\sum_i N_i M_i}\right)^{1/a}$. 2+3

(e) Give an example of the following polymers: thermoplastics, thermosets, elastomers and synthetic fibers. 2

GROUP-C

(Unit 8 and 9)

5. (a) Determine the entropy change that takes place when mixing 10 g of toluene with 10 g of a polystyrene sample with M_n = 100000 g/mol. Assume the volume of a monomer is approximately the same as a solvent molecule. Molar mass of toluene = 92 g/mol, molar mass of styrene = 104 g/mol. R = 8.314 J/(K mol) 3

(b) Which is more favourable for mixing, a high or low Flory-Huggins parameter? Why? 2

(c) Write short note on 3+3

(i) Polycarbonates, (ii) Poly (vinyl chloride).

(d) Write the structure of polypyrrole and polythiophene. 2

6. (a) Write the expression for heat of mixing in a polymer solution in terms of solubility parameter and explain the terms involved. 2+2

The entropy change of mixing of two components (1 and 2) is given by $\Delta S = -k(N_1 \ln n_1 + N_2 \ln n_2)$, where the terms have their usual significance. How is this equation modified for polymers in the Flory-Huggins equation? Give the mathematical forms of volume fractions.

(b) Write the synthesis, physical properties and uses of Bakelite. 3

(c) Discuss the methodology for the preparation of polystyrene with a flow chart. How is the impact property of polystyrene enhanced? Mention two important uses of polystyrene. 4

(d) What are silicone elastomers? Give an example. 2

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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